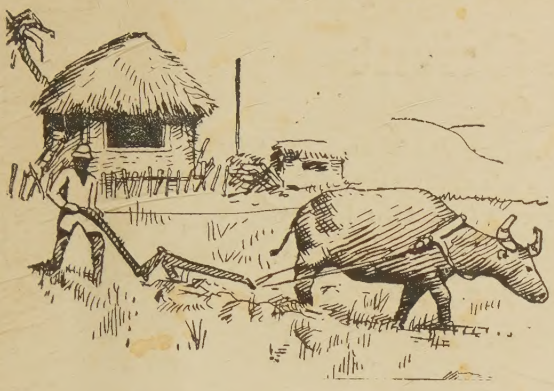
The Philippine Agriculturist and Forester



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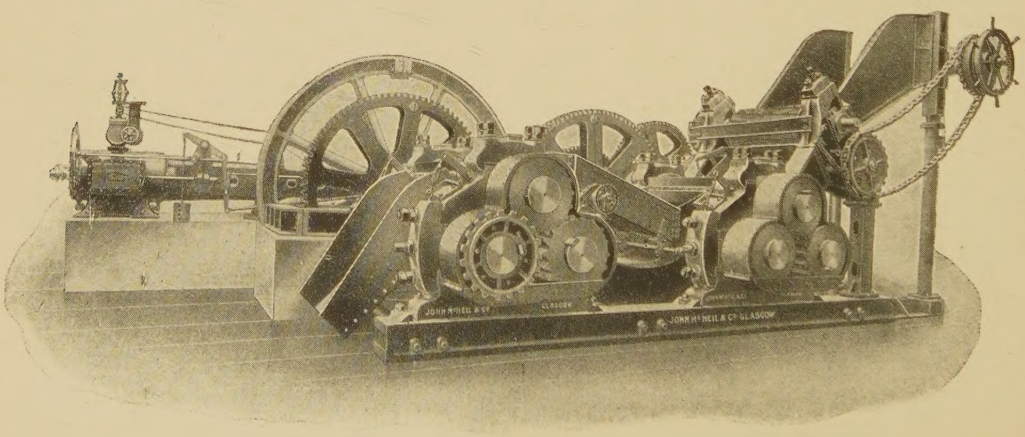

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NURSERY OF THE COLLEGE OF AGRICULTURE

THE PHILIPPINE AGRICULTURIST AND FORESTER

VOL. I. AUGUST, 1911 No. 6

REPORT ON FIELD AND NURSERY CULTURES FOR THE FISCAL YEAR 1911

MARIANO MANAS, B. S.

(NOTE:—Mr. Mariano Manas, a graduate of the Iowa Agricultural College, and at present farm foreman at this College, has had charge of the records of farm and nursery work since September, 1910. His report, submitted at the end of the fiscal year 1911, showed more than 800 distinct cultures; of these about 150 represented different varieties of rice. It is not to be understood that the College has this number of different kinds of plants, or even of varieties, in cultivation at the present time. This includes a few kinds of seed which were dead when received, or have so far failed to germinate; others which started to grow and died for one reason or another; and at least an equal number which are temporary in their nature and therefore are not always to be found growing. The report as submitted covers 208 pages. The digest which is published here has been boiled down to a size where it can be expected to have public interest, as well as value. There are omitted many details which are valuable as a part of our records, but which would not be of interest elsewhere; also, all mention of cultures which have been entirely unsuccessful, and of many which are still in doubt; and finally all strictly ornamental plants. Of the latter, there are a considerable number, as the College has its own campus to decorate and gives instruction in Horticulture and in Landscape Gardening. This report ends with June 30 of this year; in only two or three cases I have inserted a note giving information as to subsequent development.—E. B. C.)

GRASS CROPS

SUGAR CANE

30,000 tops of purple cane were secured through the Bureau of Science from the Hacienda Fortuna, San Carlos, Negros, and 3000 tops of Black cane from the Hacienda Refugio of the same locality on May 16, 1910. They have been planted by several different methods, and some of the plots were fertilized. The field was cultivated 4 times with a total cost for labor of ₱42.30, excluding the original breaking of the land. This work has been under the care of Mr. Tempongko, and the results, in the form of his graduating thesis, will be published in the Philippine Journal of Science. Work on the Purple cane is being continued by Mr. Asuncion. He planted about 1¼ hectares of land, April 26, 1911, costing ₱22.35 for labor up to the close of May. Single stalks of two other varieties of cane have been planted.

SORGHUM

Early Amber:—The original seed sown on the farm was received from the Bureau of Agriculture in 1909. Its first two generations on the farm were planted during that college year. It requires the seed about 8 days to germinate in the field, with 50 per cent germination, and about 3 months and 14 days to mature after germination. The seed has been planted in drill, as well as broadcast, covering an area of 8454 sq. m. The average yield of grain was 2275 kilograms per hectare, most of it was ground and mixed with rice middlings for chicken feed. The green forage harvested amounted to only 1198.6

kilograms per hectare, as most of it was pastured to cattle. A study of individual plants shows an average height of 1.8 m. and about 700 seed to the head, 22 of which seed weigh a gram. The fields have been cultivated once and the total cost of labor on all sorghum was ₱38.00.

MAIZE

Native Yellow:—The variety of corn which has been grown most on the farm is the native yellow corn originally found here in 1910. The seed requires about four days for germination in wet weather and 8½ in dry, showing an average stand of 69.2 *per cent*. The time required for maturity runs from two months and fourteen days in the wet season to three months and fifteen days in the dry. About 3.4 hectares have been planted to this variety, three kernels per hill at a distance of 0.80 m. by 1.00 m., yielding an average of 1770.54 kilograms of ears of corn and 3697.63 kilograms of forage per hectare, the plants measuring an average of 2.37 m. high with 1.4 ears to a plant. Most of this corn, both ears and stalks, has been fed to the cattle on the farm. Some of the good ears have been used for seed and others have been sold at the rate of five centavos a kilogram which is about 6.6 ears of corn. The fields have been cultivated about twice for each crop, the cost of which, together with the preparation of the land and the harvesting of the crops during the year, amounted to ₱103.30. No manure has been used to fertilize the land, except in one case where a small plot has been turned under with a little horse manure. This plot was planted May 22nd last and no definite results can as yet be given; but the plants show better growth than those which have not been fertilized. Our first crop on land previously in cogon and coarser grasses has usually been maize, and these crops, which are always very poor, are included in the average.

Florida White:—The seed was obtained from the Bureau of Agriculture in 1910, and planted in a small plot from which a few ears were harvested for seed. This in turn was planted October 1st, 1910, in an area of 1268.5 sq. m. at the rate of three kernels per hill and at a distance of 0.80 m. by 1.00 m. This corn produced ears December 1st, 1910, but the product consisted only of nubbins and such worthless ears that part of it was harvested for forage and the rest pastured to cattle. The field was twice cultivated and the total cost of labor amounted to ₱5.15.

Late Indian White Tall Horse Tooth Extra:—Two kilograms of seed received from Vilmorin-Andrieux & Co., Paris, March 13th, 1911. Planted April 22nd, 1911 on an area of 1718.75 sq. m. at the rate of one kernel per hill and at a distance of 50 cm. by 1.00 m.; germinated April 25, 1911, with 83 *per cent* germination. Tasselled June 8, 1911 and produced ears on June 20th. The condition of growth is fairly good. It has been cultivated once and the cost of labor on it so far amounts to ₱4.00.

Misamis Red:—One ear of this variety from Misamis was secured from the Carnival, March 2, 1911. Planted March 6, 1911 on an area of 125 sq. m. at the rate of two kernels per hill and at a distance of 0.75 m. by 1.00 m.; germinated March 13th with 69.1 *per cent* germination; tasselled April 29th and produced ears May 6th. The average height of plants was 2.15 m. and the average of ears, 1.8 to a plant. Ears matured June 21st; 101 ears were harvested, weighing 28 kilograms, the calculated production being 2240 kilograms of ears per hectare. The field was cultivated once and the cost of labor amounted to ₱0.76.

Misamis Medium Red:—One ear of this variety was secured from the Carnival March 2, 1911. Planted March 6th on an area of 125 sq. m. at the rate of two kernels per hill and at a distance of 0.75 m. by 1.00 m.

Germinated March 12th with 85 *per cent* germination. Tasselled May 2nd and produced ears May 9th. The average height of plants was 2.24 m., with an average of two ears per plant. The field was cultivated once and the cost of labor on it amounts to ₱0.56.

Several varieties of sweet corn, American and Australian, have refused to germinate. Several varieties of seed received from Prof. C. F. Baker germinated well, and three of them showed excellent promise, but were destroyed by monkeys while in the milk.

FORAGE

Guinea Grass:—Our first Guinea grass was obtained from the Alabang Stock Farm in July 1910. It was immediately planted in the field 0.6 m. by 1.00 m. apart. In October 10th, another planting was made by division of the stools from old plants, the area being about 3447 sq. m. The plants have attained an average height of 1.99 m. showing a fairly satisfactory growth. No definite yield can be given for each crop harvested, as the fields have been pastured to cattle at different times for lack of men to cut the forage. The first crop was cut 3 months and 18 days after planting, and the next successive cuttings were made at intervals of about 2 months and 13 days. The fields have been cultivated an average of 3.5 times and the total cost of labor on all guinea grass during the past year amounted to ₱30.88.

Teff (*Eragrostis Abyssinica*):—500 grams of seed were received from Vilmorin-Andrieux & Co., Paris, March 13, 1911. A part of the seed was planted in nursery flats May 9th, and germinated May 12th. The seedlings were transplanted into the field 0.60 m. by 1 m. apart covering an area of about 44 sq. m. The total cost of labor on the preparation of the land and planting of the crop amounted to ₱1.38. The plant is a forage grass, and the condition of the plants in the field is such that at present this seems the most promising plant of this kind with which we are working.

Paspalum Dilatatum:—500 grams of seed were received from Vilmorin-Andrieux & Co., March 13, 1911. A part of the seed was sown in flats in the nursery May 5th, germinating on May 12th, with only 5 *per cent* germination. Seedlings from flats were transplanted into the field June 3rd, 0.60 m. by 1.00 m. apart covering an area of 126 sq. m. The plants are promising to do well as a pasture grass which can be propagated by division of its stools. The cost of labor on *Paspalum* up to May 31st, 1911, amounted to ₱0.53.

MORAS

179 plants were planted in July 1910, 0.80 m. by 1.00 m. apart covering an area of about 1432 sq. m. The plants have made sufficient growth so that it is now ready to be propagated onto a considerable area. This species of *Andropogon* is cultivated because its roots produce an oil known as oil of vetiver, which is used in the manufacture of perfumery. Experiments made in Manila have shown that this can be made a very profitable crop on a small scale. The roots are also commonly used in the Philippines as household perfumery, like sachet powder, being put away with clothing.

LEGUMES

PEANUTS

American seed was planted Nov. 29, 1910, in hills 0.80 m. by 1.00 m. apart at the rate of two seed per hill, covering an area of 185.94. Germinated December 5, 1910, with 70 *per cent* germination and commenced to set fruit April 3, 1911, which matured June 27, showing a yield of about 5000 kilos unshelled peanuts per hectare. The field has been twice cultivated and the total cost of labor amounts so far to ₱3.85.

SINCAMAS

Pachyrrhizus Angulatus:—One sack of unshelled seed was purchased for ₱2.15 including delivery, from Calamba, Nov-

ember 22, 1910. The seed was planted November 25, in hills 0.25 m. apart in rows 1.00 m. apart, at the rate of 2 seeds per hill, covering an area of about 2972 sq. m. Germinated December 1st with 84 *per cent* germination. The roots matured March 15, 1911. The plants then shed their old leaves which were replaced with new ones about April 16. A portion of the crop has been left in the field to produce seed, while the rest has been harvested, yielding at the rate of 4224 kilos per hectare with a market price in Los Baños of about 2.5 centavos per kilo. The fields have been cultivated 2.5 times and the total cost of labor amounted to ₱31.65.

COW PEAS

The only variety that has shown any success in our planting of cow-peas is the New Era. Clay Colored and Black Eye varieties have also been tried, but have both failed to germinate. The New Era seed was received from the Bureau of Agriculture in 1910. The seed requires an average of four days to germinate, with 66.1 *per cent* germination. The average time required for the plants to set fruit is two months and eight days, and the number of days still required for maturity of fruit is about 16. The seeds were planted in hills 0.3 m. apart, in rows 1.00 m. apart. The total area planted during the year was 9166 sq. m. with an average rate of yield of 1231.6 kilograms per hectare. The plants have proven good forage for cattle when cut green. The number of pods produced averages 21.5 to the plant, and the average weight 2.6 gr. per pod. They may be served at table as beans when young; but when they pass this stage they become bitter. Each crop has been cultivated on an average 1.5 times, and the total cost of labor on all cow-peas grown during the year was ₱40.60.

BEANS: NATIVE

Senay:—One small package of seed received from Pangasinan through the Carnival, March 2, 1911. Planted March 6th in hills, 3 seeds per hill, 0.80 m. by 1.00 m. apart, covering an area of 113.6 sq. m. Germinated March 16th with 41.3 *per cent* germination. They are small wild climbing plants and were trellised with bamboo June 25, 1911. They have been cultivated twice and the total cost of labor on the crop amounted to ₱3.32.

Agayep:—A small package of seed received from Pangasinan through the Carnival March 2, 1911. Planted March 6th in hills, 3 seeds per hill, 1.00 m. by 1.2 m. apart, covering an area of 27.6 sq. m. Germinated March 14th and trellised with bamboo April 26th. The height of plants runs at an average of 1.4 m. The field was cultivated twice and the total cost of labor was ₱0.83.

Batao (Dolichos Lablab):—A package of seed received January 10, 1911. Planted on January 13th in hills, 3 seeds per hill and 1.00 m. apart, covering an area of 184 sq. m. Germinated January 20th with 36.7 *per cent* germination. The seeds were planted by a bamboo brush and did not necessitate any furher trellis for climbing. They are growing slowly and not showing any fruit development. The cost of labor on planting was ₱1.60.

Saboil:—Seed received from Pangasinan through the Carnival. Planted March 7th in hills, 3 seeds per hill, 1.00 m. by 1.2 m. apart, covering an area of 19.2 sq. m. Germinated March 15th with 58 *per cent* germination. The plants were trellised with bamboo, April 29th. They are growing very vigorously, measuring 1.85m. high and producing about 98 pods to a plant. Each pod is fairly large, averaging, 7.62 cm. long and containing 5 seeds. The pods are produced in clusters of 5 more or less. The shell is the part which is usually eaten, when cooked young. The plant is still found in its wild habitat, and is probably a variety of the Lyon velvet bean. The field has been cultivated twice and the cost of labor amounted to ₱1.24.

Puleminco (*Phaseolus lunatus*:)—Seed received from Pangasinan through the Carnival. Planted March 6th in hills, 3 seeds per hill, 1.00 m. apart, covering an area of 14 sq. m. Germinated March 16th with 50 *per cent* germination. The plant were trellised with bamboo, April 29th. They have been cultivated twice and the total cost of labor amounted to ₱0.41.

Sitao (*Dolichos sesquipedalis*:)—A few seed received from Tarlac through the Carnival. Planted March 6th in hills, 3 seeds per hill, 1.00 m. by 1.2 m. apart covering an area of 4.8 sq. m. Germinated March 15th with 55 *per cent* germination. The plants were trellised with bamboo April 29th. Produced pods May 17th, which commenced to mature June 21st. Each plant shows so far about 13.5 pods, averaging 20.32 cm. long and containing an average of 18 seeds. The field was twice cultivated and the total cost of labor was ₱0.16.

Frijoles (*Phaseolus vulgaris*:)—Seed received from Tarlac through the Carnival on March 2, 1911. Planted March 6th in hills, 3 seeds per hill, 1.00 m. by 1.2 m. apart, covering an area of 14.4 sq. m. Germinated March 15th with 50 *per cent* germination. The plants are growing fairly well. They were cultivated twice and the total cost of labor amounted to ₱0.41.

Patani (*Phaseolus lunatus*:)—Seed received from Lipa, Batangas, April 18, 1911. Planted immediately in the nursery field in hills, 4 seeds per hill, 0.60m. by 1.00 m. apart, covering an area of 14.5 sq. m. Germinated April 23rd with 83.3 *per cent* germination. Trellised with bamboo June 1st. The plants are growing well. They have been cultivated twice and the cost of labor amounted to ₱0.61.

BEANS: IMPORTED

Dolique de Cuba:—Seed received from Vilmorin-Andrieux and Co., Paris, March 13, 1911. A part planted March 21st, in nursery field in hills, 4 seeds per hill, 0.60 m. by 0.90 m. apart, covering an area of 52.2 sq. m. Germinated March 24th with 75.25 *per cent* germination. Trellised with bamboo on April 18th. The height of plants is from 1.5 m. to 1.8 m. The plants produced pods May 7th which commenced to mature May 16th. The average number of pods produced from one plant was 4.5 averaging 26.4 cm. long and 3.239 grams in weight. The estimated yield per hectare is 617.2 kilograms at a market price of about 25 centavos per kilogram. The plants were attacked by maggots which infested the roots first and then the stems causing 24 *per cent* of them to die, April 7th to 19th' before setting fruits. The infected plants were gathered and burned to avoid further spread of the pest. The field was cultivated three times and the cost of labor amounted to ₱0.61.

Haricot du Cap marbre (*Phaseolus vulgaris*:)—250 grams received from Vilmorin-Andrieuz & Co., Paris, March 13, 1911. Planted March 21st in hills, 4 seeds per hill, 0.60 m. by 0.90 m. apart covering an area of 52.2 sq. m. Germinated March 27th with 54.7 *per cent* germination. Trellised with bamboo April 18th. The height of plants is about 1.8 m. The plants were attacked by the maggot as mentioned above which first infested the roots and then the stems causing 28.7 *per cent* of the plants to die from April 7th to 19th before setting fruits. The affected plants were gathered and burned. The field was cultivated three times and the total cost of labor amounted to ₱3.09.

Haricot de Lima:—250 grams received from Vilmorin-Andrieux & Co., Paris, March 13, 1911. Planted March 22nd in hills, 4 seeds per hill, 0.60 m. by 0.90 m. apart, covering an area of 52.2 sq. m. Germinated March 27th with 52.5 *per cent* germination. Trellised with bamboo April 19th. The plants, average height is about 2 meters. They commenced to bear flowers May 11th, setting pods about June 18th.

The plants were attacked by the maggot mentioned above, which caused 41.9 *per cent* of them to die before setting fruits. The infected plants were gathered and burned. The field was cultivated three times and the cost of labor amounted to ₱3.09.

Dolique Mougette:—250 grams received from Vilmorin-Andrieux March 13, 1911. A part of the seed were planted March 22nd, in hills, 4 seeds per hill, 0.60 m. by 0.90 m. apart covering an area of 52.2 sq. m. Germinated March 22nd with 76 *per cent* germination. The height of plants is from 0.50 m. to 0.60 m. The plants produced pods May 15th which commenced to mature May 24th. The average number of pods produced from one plant was 6, each pod measuring 13.3 cm. long and weighing 2.234 grams. The estimated yield per hectare is 273.15 kilograms at a market price of about 25 centavos per kilogram. The plants were attacked by the same maggot causing 63.8 *per cent* of them to die before setting fruits. The field was cost cultivated three times and the total of labor was ₱.61.

Haricot jaune de la Chine (*Phaseolus vulgaris*:)—500 grams of seeds received from Vilmorin-Andrieux March 3, 1911. A part of seed planted March 22nd, in hills, 4 seeds per hill, 0.60 m. by 0.90 m. apart, covering an area of 52.2 sq. m. Germinated March 27th with 49.5 *per cent* germination. The height of plants is 0.50 to 0.60 m. The plants were attacked by the maggot mentioned above causing all of them to die April 7th to 19th without setting fruits. The infected plants were gathered and burned to avoid further spread of the pest. To get rid of the maggot an area of 10 sq. m. was treated with 2 kilos of lime and replanted to this variety of beans on April 7th. The seeds germinated as before but presently they too were killed without exception. The field was cultivated three times and the total cost of labor amounted to ₱0.73.

Dolique du Tonkin:—Seed received from Vilmorin-Andrieux & Co. March 3, 1911. A part sown in nursery field March 22nd, in hills, 4 seeds per hill, 0.60 m. by 0.90 m. Germinated on March 25th with 86 *per cent* germination. The height of plants is about 30 cm. The plants produced pods on May 16th which commenced to mature on May 27. The average number of pods produced from one plant was 12, each pod measuring 9.08 cm. long and weighing 1.02 grams. The estimated yield per hectare is 129.43 kilograms at a market price of about 25 centavos per kilogram. The plants were attacked by the maggot as mentioned above causing 83.4 *per cent* of them to die before setting any fruit. The field was cultivated three times and the cost of labor amounted to ₱0.61.

Tres Hatif Long Grosse (*Doliches*:)—Seed received from Vilmorin-Andrieux, March 3, 1911. Planted in nursery field March 20th in hills of 4 seeds 0.60 m. by 0.90 m. apart covering an area of 26.1 sq. m. Germinated on March 22nd with 64.2 *per cent* germination. The height of the plants is from 1.42 m. to 2.4 m. Trellised with bamboo, April 24th. They commenced to bear flowers April 25th and set pods on May 1st which matured May 17th. The average number of pods produced from one plant was 4.2 each pod measuring 9.08 centimeters and weighing 2.951 grams. The estimated yield per hectare is 394.75 kilograms. The plants were attacked by the root maggot causing 33 *per cent* of them to die before setting any fruit. The field was cultivated three times and the total cost of labor amounted to ₱1.01.

MISCELLANEOUS LEGUMES

Calamismis (*Psophocarpus tetragonolobus*:)—42 seeds received from Lipa, Batangas, April 18, 1911, and planted in hills of 3 seeds 0.80 m. apart covering an area of 11.2 sq. m. Germinated April 25th with 58.3 *per cent* germination. The height of plants averages more than 2 meters and

the plants show a promise of a good yield. The field was cultivated twice. Calamismis is a kind of bean bearing a curious four sided pod, about 18 cm. long with a foliar fringe along its four corners. The whole pod is eaten boiled when young. In some Parts of India and Indo-China this plant is cultivated mainly for its tuberous roots. (See Current Literature, No. IV, Vol I, of this Journal).

Spanish Lentil (*Lathyrus sativus*:)—1 kilo seeds received from Vilmorin-Andrieux & Co. March 13, 1911. A part of seed sown on May 12th in hills of 3 seeds, 0.60 m. apart covering an area of 26.1 sq. m. The plants are over 0.60 m. high showing a fair growth.

Cagyos (*Cajanus indicus*:)—Seed received from Lipa, Batangas, April 18th, 1911. and planted immediately in flat. Germinated April 21st with 94 *per cent* germination. Transplanted into the field, May 2nd, in hills 1 meter apart, covering an area of 154 sq. m. The plants which are ereet are now about 0.90 m. high.

"Chick Peas" (*Garbanzos*):—Seed received from Vilmorin-Andrieux & Co., March 13th, 1911. A part of the seed planted in rows 0.90 m. apart covering an area of 26.1 sq. m. Germinated May 25th. The plants made a fairly good start, only about 8.6 *per cent* of them having been killed by root maggots; afterward, however, they all died before forming any fruit. An attempt to grow this plant the preceding year resulted in the same way, flowers being produced but no fruit.

Pois sans parchemin fondant de St. Désirat.—Seed received from Vilmorin-Andrieux & Co., March 13, 1911. A part of the seed planted in the nursery field March 20th in rows 0.90 m. apart, covering an area of 26.1 sq. m. Germinated May 25th. Produced pods May 10th, maturing May 18th. The plants were at an average of 0.91 m. high each bearing about 2 pods. Each pod measured 4.9 cm. long and weighed 2.348 grams. Cultivated three times; the cost of labor, ₱0.28.

Pois sans parchemin beurre.—Pois beurre—Seed received from Vilmorin-Andrieux & Co., March 13th, 1911. Planted as the preceding variety. Germinated on March 25th. Produced pods May 10th, maturing May 18th. The plants were at an average 0.83 m. high, each bearing about 3 pods. Each pod was 4.76 cm. long and weighed 1.522 grams.

Pois sans parchemin Corne-de-bélier—Seed received from Vilmorin-Andrieux & Co., March 13th, 1911. Planted in hills 60 cm. by 90 cm. apart covering an area of 52.2 sq. m. Germinated March 26th with 48 per cent germination. Produced flowers May 1st. Set fruits May 16th which matured May 20th. The plants were attacked by the root maggot which destroyed the beans, causing 45 *per cent* of them to die before bearing fruit. The average height 0.785 m., each bearing only 1.5 pods. Each pod measured 6.1 cm. long and weighed 2.094 grams. Cultivated twice; cost of labor, ₱0.56.

ROOT CROPS

CASSAVA

There are four varieties of cassava now growing on the farm, namely, *Capo Colorado*, a fast growing variety rooting 90 per cent; *Capo Puti* a slower growing variety rooting 82 per cent. Camunting, a fairly fast-growing variety rooting 86 per cent; and the local variety, a rather slow-growing one. The first three varieties were obtained from the Moro Province in June 1910. The distinguishing features of these varieties are as follows: Capo Colorado has red petioles; Capo Puti has white petioles and roots; Camunting, petioles colored greenish red; and the local variety differing from the Camunting in that its petioles are much less tinged with red. All these varieties including the local one were planted in June 1910, in an area of 1642.2 sq. m. at a distance of 1 m. by 1.2 m. Later plantings have been

made from the three Moro varieties, first on Nov. 10, 1910 covering an area of 2482.2 sq. m. and then on December 29, 1910 and January 4, 1911, the plantings occupying an area of 1044 sq. m. The cuttings have rooted generally within eleven days after planting, those from younger wood sprouting earlier than those from old wood, but the latter showing more thrifty subsequent development. A comparison of the growth made by the young plants planted November 10, 1910 as measured on May 29, 1911, is as follows: Capo Colorado 1.81 m. high; Capo Blanco 1.19 m. high; and Camunting 1.7 m. high.

Several plants of each of the Moro varieties have been harvested, November 11, 1910, and March 29, 1911. The average weights of product per plant of each variety harvested have been found as follows: Capo Colorado, 4.58 kilograms; Capo Puti, 2.24 kilograms; and Camunting, 2.50 kilograms. Cost of labor on all cassava amounts so far to ₱38.76.

SWEET POTATOES

The only variety of sweet potatoes grown on the farm is the so called "Beattie Camote" brought over from California by Mr. G. W. Beattie. It propagates very readily from stem cuttings about 40 cm. long and planted, 0.5 m. by 1 m. apart. The greatest time required for maturity has been 6 months and 13 days. The area planted to sweet potatoes consisted of about 4156.9 sq. m. from which an average yield of 5725 kilograms per hectare has been obtained. This average is not representative, as it includes plots injured by wild hogs. A plot not attacked yielded at the rate of 8200 kilos per hectare. The crop has been graded into large, and small and worthless potatoes. The large potatoes have been sold at 3 centavos per kilogram while the small and worthless grades have been fed to hogs. The fields have been cultivated 2.5 times and the total cost of labor amounted to ₱48.78.

TACCA PINNATIFIDA

(Tagalog name, *Yabyaban*:)—The tubers of this plant were obtained from Batangas through Mr. Laparan in December 1909. Some of these were planted in the nursery, some in the open field, and some on an uncultivated bank of the creek. All of them grew satisfactorily. Those on the creek bank have been left to themselves where they continued to thrive. The others have been multiplied to some extent in the nursery, but the tendency seems to be to decrease in size from year to year. Seeds were obtained from this plant September 8, 1910, and immediately planted. Their germination began February 17, following and continued for a month. These have been placed in separate pots and have continued to grow slowly. The period of activity during each year lasts only a few months during which the plant puts up one or a few large leaves and a long scape with a cluster of flowers.

It remains questionable whether or not this plant can be cultivated successfully in our soil. In the Philippines it is strictly confined to sandy beaches in which situations it is widespread, being native from Polynesia to Madagascar. The tubers contain a large quantity of valuable starch which is remarkably easy to extract. Tubers obtained from Cavite Province and examined in the Bureau of Science have shown 22 per cent of starch washed out after rasping with a hand grater. The plant is an important one in Polynesia where it is known as Pia. It is cultivated at altitudes reaching up to 200 m. The starch is known in commerce as Tahiti arrowroot. There is some confusion in works on tropical agriculture between *Tacca* and *Amorphophallus*. The two plants are alike in having large fleshy tubers and very large compound leaves. The tuber of *Amorphophallus* however is comparatively valueless either as a food or as a source of starch. It is known in Tagalog

as *Poñgapong*, and is used to some extent as food for hogs. *Tacca* is used as a source of starch for sweet-meats. To the Manila markets, it comes chiefly from Zambales and to some extent from other neighboring seashores.

YAMS

Calut (*Dioscorea hirsuta Blume*):—5 roots received from Tarlac through the Carnival. Planted in nursery field March 5th; all sprouted March 19th. The plants have developed into tall vines, producing flowers from April 14th.

"Tugui" (*Dioscorea*):—6 tubers received from Tarlac through the Carnival March 2, 1911. Planted March 5th in the nursery 1.5 m. apart. All the tubes sprouted by March 20th and all are growing well around the nursery building.

Ube, "Cabusoc," Dioscorea Alata:—One tuber received from Pampanga through the Carnival, March 2, 1911. Planted by the nursery house March 5th. Sprouted April 4th, and is now growing well. The roots of this root crop are long, fairly large, and light violet in color.

Ube, "Binaksan," Dioscorea Alata:—Three tubers received from Pampanga through the Carnival. Planted by the nursery house March 5th. Sprouted March 28th and now growing well. The roots of this variety are long, crooked, and dark violet in color.

Ube, "Kinampay," Dioscorea Alata:—Three tubers received from Pampanga through the Carnival. Planted by the nursery house March 5th. Sprouted April 2nd and are now growing well. The roots of this variety are large and round.

GINGER

Zingiber Officinale:—Ten rhizomes received from Vilmorin-Andrieux & Co., March 13, 1911, coming originally from the West Indies. Planted in the nursery field March 16th. All rooted by March 21st and are now growing well. The ginger of local growth in the Philippines contains much less oil than that of commerce.

ARROW ROOT

Maranta Arundinacea:—Three roots were secured from Mr. Pedro Erizo, Pangasinan, through the Carnival, March 2, 1911. They were planted in the nursery field 60 cm. apart on March 5th. Only one sprouted, on March 24th, but this one shows good growth.

POTATOES

Some potatoes, probably Japanese, planted January 13th. 60 cm. by 1 m. apart, covering an area of 142.6 sq. m. Sprouted January 30th. Produced flowers on February 14th. Crop harvested April 3 amounted to 5.5 kilos from which it is estimated that a hectare will produce about 385 kilos. These potatoes have been planted again in an area of 171 sq. m. Sprouted May 22nd with a very low percentage of sprouting. This experiment would seem to indicate that the potato will not thrive here, but we are not ready to draw this conclusion.

MUSA ENSETE

Seed received March 13, 1911, from Vilmorin-Andrieux & Co. Planted immediately in flat; germinated April 2nd with 60 *per cent* germination. Transplanted into pots April 7th, and into the field May 9th, spaced 2 meters. The commonest Musa in cultivation as a decorative plant. In its native country, Abyssinia, it is cultivated for the sake of the underground stems which provide a food rich in starch.

GABI

(*Colocasia Antiquorum*):—38 roots were received from Mindoro through the kindness of Capt. Van Schaick in November 1909, and planted immediately in the nursery field 1 m. apart covering an area of 38 sq. m. On February 1st there were harvested 7.2 kilos of rhizomes from ten hills, and immediately planted on an area of 382 sq. m. rooting about 70 *per cent* March 5, 1911.

One small sack of another variety was secured locally February 1st, 1911. This

was planted in hills 1 m. apart covering an area of 88 sq. m. They rooted 90 *per cent* on March 8th and have shown good growth since the fall of the first showers in April. The cost of labor on this variety was ₱.68.

A third variety consisting of only a few individuals was secured from the province of Tarlac through the Carnival and planted in the nursery field 1 meter apart on March 5th, all rooting on March 27th.

A report on yautia (*Xanthosoma*) has already been published.

BEETS

Early Blood Turnip:—One packet of seed received from Cincinnati, January 10, 1911. Sown January 12th, 0.2 m. apart in rows 1 m. apart, covering an area of 5.7 sq. m. Germinated on January 22nd with only about 25 *per cent* germination. The roots, which are the part eaten, matured on April 20th, yielding about 20 *per cent* marketable product and weighing 0.54 kilos per bunch of 12. The estimated yield per hectare of marketable product is about 208 bunches weighing 112.32 kilos which are usually sold in the market at about 20 centavos per bunch. The field was cultivated twice and the cost of labor was ₱0.66.

Egyptian:—One packet of seed received from Cincinnati, January 10, 1911. Sown January 12th, 0.2 m. apart in rows 1 m. apart covering an area of 5.7 sq. m. Germinated January 21st with 78 *per cent* germination. The roots matured April 16th, yielding about 32.5 *per cent* marketable product, and weighing 0.63 kilo per bunch of 12. The estimated yield per hectare of marketable product is about 1056 bunches weighing 665.28 kilos which may be sold in the market at a little less than 20 centavos per bunch. The field was cultivated twice and the cost of labor amounted to ₱.66.

Rouge Noir Plat d'Egypt.—Seed received from Vilmorin-Andrieux & Co., Paris, March 13, 1911. Sown in nursery field March 20th, in rows 90 cm., apart covering an area of 26.1 sq. m. Germinated March 27th. The plants are growing fairly well, but are not yet showing any roots that are fit for use. The field was cultivated twice and the cost of labor so far amounts to ₱.37.

Rouge Ronde Precoce:—Seed received from Vilmorin Andrieux & Co., Paris, March 13, 1911. Sown in nursery field March 20th, in rows 90 cm. apart, covering area of 26.1 sq. m. Germinated March 25th. The plants have been thinned out to 2 dm. apart. They are growing well but are not yet showing any marketable roots. The cost of labor on them amounts to ₱.42.

ONIONS

From Manila Market.—5 bulbs received January 12th, 1911. Planted in the field January 14th, 2 dm. apart. All sprouted by January 20th, and produced flowers April 12th. The plants were divided up into 16 sprouts and transplanted into the nursery field, June16th.

Egyptian:—100 bulbs received from Vilmorin-Andrieux & Co., March 13th, 1911. Planted in the nursery bed 2 dm. by 4 dm. apart covering an area of 8 sq. m. All but one sprouted by March 26th and commenced to produce tops April 20th. The average height of the plants on May 31st was about 46.6 cm. and the number of leaves found on each plant was eight. This variety of onion does not produce large bulbs but they are mainly used as greens which may be sold in the market for about twenty centavos per bunch of twelve. The cost of labor on the crop was ₱.96.

Jaune paille des vertus:—Seed received from Vilmorin-Andrieux & Co., March 13th, 1911. A part of the seed sown in nursery flat March 15th. Germinated March 22nd. Transplanted into the nursery bed March 30th., 2dm. by 4dm. apart, covering an area of 3.76 sq. m. Only very few of the plants have survived, due to rain storms during

April, which washed the plants away. The cost of labor on the crop was ₱1.92.

Flat Madeira.—Seed received from Vilmorin-Andrieux & Co., March 13th, 1911. Sown in nursery flat March 15th. Germinated March 20th. Transplanted into the nursery bed March 30th., 2 dm. by 4 dm. apart, covering an area of 3.76 sq. m. The cost of labor on the crop was ₱1.13.

Round Madeira:—15 grams of seed received from Vilmorin-Andrieux & Co., March 13th, 1911. Sown in nursery flat March 15th. Germinated March 22nd. Transplanted into the nursery bed March 30th 2dm., by 4dm. apart covering an area of 3.76 sq. m. The cost of labor on the crop was ₱1.13.

Blanc hatif de Paris:—Seed received from Vilmorin-Andrieux & Co., March 13, 1911. Sown in nursery flat March 15th. Germinated March 22nd. Transplanted into the nursery bed March 30th, 2 dm. by 4 dm. apart, covering an area of 3.76 sq. m.

MISCELLANEOUS GARDEN PLANTS

Very many of the common garden plants of temperate countries have been tested. Some of these, as radishes, succeed under almost any treatment; others, such as strawberries, and onions must be handled just right. But few of these plants are taken up in this report, as nearly all of the seed arrived so late in the year that they could not be given a good chance. The report for the coming season will contain notes from both years.

PASSIFLORA QUADRANGULARIS

Granadilla:—Seedlings grown from Australian seed obtained from Mr. Veston of Manila in October, 1910. Transplanted into the field November 5. As the plants developed they were provided with a strong trellis of bamboo and heavy wire. Flowering began March 24, the first fruit was set April 10. First fruit was collected for seed June 6. This vine with its very large and fragrant flowers would be valuable as an ornamental alone, but produces edible fruit in large quantities. Two of our plants which are growing intertwined are bearing 50 kilograms of fruit at this time.

OKRA

(*Hibiscus esculentus*:)—Seed received from Vilmorin-Andrieux & Co., March 13, 1911. A part of seed planted in flat May 2nd. Germinated May 5th with 76 *per cent* germination. Transplanted into the nursery field May 26th, 80 cm. by 90 cm. apart, covering an area of about 17.3 sq. m. Okra from local seed has been the most reliable garden plant tried here. It will bear heavily at any time of year.

ROSELLE

Hibiscus Sabdariffa:—An annual plant the fruit of which is used for making jelly or to flavor drinks. We have received two strains of this plant. The first was received in October 1910, brought by Dr. Foxworthy from the Hawaii Experiment Station. It was sown in flat October 20, and germinated October 22nd with 84 *per cent* germination. Transplanted in flats October 27th and set out in the field December 16th; spaced 1 meter, occupying 89 sq. m. It began to flower December 26th when 3 dm. high. Beginning February 25th, the fruit was collected and saved for seed. The yield was only about 8 fruits per plant. These seed were dried, stored, and sown in flats May 20th. Instead of dieing, the parent plants partly dried up, and with the advent of wet weather in June they renewed their growth, and seem likely this season to reach a normal size.

The other strain was received from the Bureau of Agriculture May 26th, 1911. This was planted at stake, 4 seeds per hill, spaced 1 meter. Germinated May 31st with 67 *per cent* germination. Thinned to two plants per hill and the thinnings transplanted to new hills. June 10, the remaining seed was planted in the same way. All plants are now growing well.

HIBISCUS ABELMOSCHUS

Seed received March 13, 1911, from Vilmorin-Andrieux & Co. Planted in flat March 16; germinated March 20, subsequently transplanted to field and spaced 1 meter. This plant produces a sort of musk and is also of value as an ornamental.

HEDYCHIUM CARONARIUM

Camia:—Plants received October 12, 1910, and planted in nursery field. They are growing well and flowering freely. It is very probable that this plant could be used industrially as a source of essential oil. It is a popular cultivated plant in the Philippines because of its sweet-scented flowers.

CARTHAMUS TINCTORIUS

Safflower:—Seed received from Vilmorin-Andrieux & Co. March 13, 1911. Planted in flat March 16; germinated March 18 with 5 *per cent* germination. Spaced 1 meter apart in the field, May 26. This plant is grown locally and used to color food.

ELETTERIA CARDAMOMUM

Seed received March 13, 1911, from Vilmorin-Andrieux & Co. and immediately planted in flat; germinated May 17th.

MENTHA PULEGIUM

Mint:—Seed received March 13, 1911, from Vilmorin-Andrieux & Co. Planted in flat May 14; germinated June 3, and now growing well.

POGOSTEMON PATCHOULI

Seed received March 13, 1911, from Vilmorin-Andrieux & Co. Planted immediately in flat; germinated March 22. This plant is found without cultivation in the neighborhood of Manila, and produces seed here. In cultivation in India it is said to seed rarely if at all. It produces a perfume in use in India.

RICINUS COMMUNIS

"*Castor-Oil*:"—Seed received from Pangasinan March 2, 1911. Planted at stake April 10; germinated April 19. Now growng well.

FIBER PLANTS

MUSA TEXTILIS

Abaca:—Several hundred hills of abaca were growing in a ravine on the College farm at the time of its purchase, and this patch has been the source of all material for subsequent work with this plant. During the past year about 50 hills were planted in the grove of cocoanuts where the shade was so dense that the subsequent growth has been very slow. Another small planting on half-cleared forest land has resulted in the same way, while the plants set on an open hill side, where it was anticipated that it would be too dry for abaca to thrive at all, have shown a very satisfactory growth. Beside this, a third of a hectare of land was planted with abaca in May 1911, the hills being spaced 2.5 meters in each direction. A third of these are among cocoanuts now coming into bearing, a third are among cocoanuts of half of this size which do not yet shade the ground, and a third are in the open sunshine. The results of the work on abaca have already been published in the June number of this magazine, and a separate report will be made on this work for the coming year. The total cost of planting and cultivating of abaca to date is ₱15.73. Aside from this, the College has a few plants which were received from Batangas.

PANDANUS SABUTAN

Suckers of sabutan have been obtained from Tanay, Rizal, in November 1909, and from Mavitac, Laguna, during the following month. These were planted in the open sunshine in the field, in the nursery, and under the shade of cocoanuts. Of the plants planted in the sunshine, the germination was very unsatisfactory, while about 70 *per cent* of those in the cocoanuts lived. The subsequent growth of the shaded plants however was comparatively slow. The survivors of the sabotan in the nursery show a very thrifty growth, and at present bear an average of 7.5 suck-

ers to each mother plant. The leaves are already of such a size that they could be utilized. The cost of labor on sabotan has been ₱1.75.

CARLUDOVICA PALMATA

A plant related to the palms and closely resembling a Fan Palm. It is the plant from which the so-called Panama hats are made. One plant, originally from Singapore, obtained from Lamao in 1910, and planted in the nursery field. It grows very vigorously under half shade, producing suckers beginning May 9th. Seed received later under this name was false.

AGAVE FOURCROYDES

Seed received from Cuba, November 10, 1910, and sown immediately in flat. Germinated November 30th with about 90 *per cent* germination. A part of the seedlings transplanted to bed March 2nd 1911, 40 cm. apart. These were afterward hoed out by mistake, and had to be replaced with new seedlings June 24th.

AGAVE MEXICANA

Seed received March 13, 1911, from Vilmorin-Andrieux & Co. Planted in flat March 15th; germinated March 24th with 36 *per cent* germination.

FURCRAEA GIGANTEA

Mauritius Hemp:—Seed received March 13, 1909, from Vilmorin-Andrieux & Co. Germinated in flats, and transplanted to field, March 28, spaced 3 meters. With and among the other fiber plants which thrive in these Islands, it is doubtful that the culture of Mauritius hemp could be made profitable. Because of its great size it is a desirable ornamental for use on large grounds.

SANSEVIERA ZEYLANICA

"Tigre"—"Bowstring Hemp." This plant is in common local use, to make decorative borders, and along roads and in hedgerows. Plants were obtained locally, August 23, 1910. Flowered March 25, 1911. This is easily reproduced by cuttings of the leaves. An exceptional strong fiber is produced by the plant, but it is not exploited in the Philippines.

BOEHMERIA NIVEA

China Grass:—One hundred grams of seed received from Vilmorin-Andrieux & Co., Paris, March 3, 1911. The seed was planted in flats and then set out into the field, 1 meter apart. It requires 6.5 days for the seed to germinate, with about 40 *per cent* germination. The cost of labor on it amounts so far to ₱0.63. China grass is a well known fibre plant, which is also sometimes grown for an ornamental. It is very sensitive to heat and dryness, and should therefore be carefully protected and thoroughly watered for several days after transplanting.

INDIAN HEMP

Seed received from Vilmorin-Andrieux & Co., Paris, March 13, 1911. A part of the seed was planted in flats on May 12th. Germinated on May 17th with only 4 *per cent* germination. Indian hemp is used for its fibre and sometimes as the source of a drug.

COTTON

Two strains have been received from the Botanic Garden, Pomona College, Claremont, California, April 17, 1911. One is Large Boll A, consisting of 11 seeds, planted in a flat on April 18, of which only one germinated, April 21st. Transplanted into a bamboo pot, April 28th. The other strain is Large Boll B consisting of 28 seeds, planted in a flat April 17, germinated April 21, with 44 *per cent* germination; and transplanted into bamboo pots April 28.

CEIBA PENTANDRA

Kapok:—One fairly old tree grows on the farm and produced pods January 12, 1911, which matured May 13th. Seeds from Tarlac and Pangasinan was obtained at the Carnival. Fifty seeds from Tarlac were planted in a flat, April 10, 1911; germinated April 13, with 50 *per cent* germination; and were transplanted into bam-

boo pots April 25, to be set out into the field later. The Pangasinan seeds were planted in part in a flat April 10, germinated April 17th, and were transplanted into bamboo pots May 5th.

RUBBER

CASTILLOA

29 young trees obtained from Cementerio del Norte, Manila, in May 1910 and planted 4 meters apart. Several of the trees commenced to set fruit May 10, 1911, which matured June 13th, and is being dried for planting. The average circumference of 25 trees one meter from the ground is 12.93 cm. The field was cultivated three times and the cost of labor on it during the year was ₱8.00. Thi, is one of the species of Mexican rubbers received under the name of Castilloa elastica, which it probably is not.

HEVEA BRAZILIENSIS

Pará Rubber:—2000 seeds were received from J. D'A. Pereira, Singapore, December 22, 1910. These seeds have been collected from trees 10 to 12 years old, according to Mr. Pereira. They were planted December 23 rd, in seed beds, 2 dm. by 5 cm. apart. Germinated on December 30th with about 70 *per cent* germination. 140 plants were directly transplanted into the field on February 6, 1911, 6 m. apart, covering an area of 5040 sq. m. About 55 *per cent* of vacancies, resulting chiefly from attacks by deer, were filled March 3rd. The stand of the growing plants only shows 20 *per cent* on June 21st, due to further damage by deer and to dryness. The field has been twice cleared of tall grass, the cost of labor amounting to ₱49.06.

MANIHOT DICHOTOMA

Jaquié Rubber:—3000 seeds were received from Vilmorin-Andrieux & Co., Paris, December 12, 1910. They were planted December 13th in seed bed, 2 dm. by 5 cm. apart, after filing near the micropyle to facilitate germination. Germination began December 21, reaching about 65 *per cent*. The seedlings were transplanted into bamboo pots January 24, 1911, and 140 plants were transplanted into the field February 6, 4 m. apart. About 50 *per cent* vacancies resulting from damage by deer and drought, were replaced March 6. The stand of the growing plants shows 76.32 *per cent*, June 21st. The field has been twice cleared of tall grass, the cost of labor amounted to ₱52.86.

MANIHOT GLAZIOVII

Ceará Rubber:—Seeds received from La Carlota Experiment Station through the Bureau of Agriculture, in February 1910, and planted immediately in the nursery. There are only two plants now living, one of which produced flowers April 3, 1911. which developed fruit by April 24th.

MANIHOT PIAUHYENSIS

1000 seeds were received from Vilmorin-Andrieux & Co., Paris, December 5, 1910. They were planted December 6th, in seed bed, 2 dm. by 5 cm. apart, after filing. Germinated December 22nd, with about 60 *per cent* germination. The seedlings were transplanted into bamboo pots January 28, 1911, and 140 plants moved into the field February 6, placed 4 m. apart. About 40 *per cent* vacancies were caused by deer and drought, and were filled March 11th. The stand of growing plants is 78.95% on June 21. The field has been cleared twice, the cost of labor being ₱56.76.

MANIHOT HEPTAPHYLLA

1000 seeds were received from Vilmorin-Andrieux & Co., Paris, on March 13, 1911. They were planted March 20th, in bamboo pots, after filing. These seeds commenced to germinate on May 2nd with a very irregular and poor germination of only 8.29 *per cent*.

MARSDENIA VERRUCOSA

Seed received March 13, 1911, from Vilmorin-Andrieux & Co. Planted in flat March 22; germinated April 3 with only 5 *per cent* germination. Transplanted to field July 5.

(*To be continued*)

SILKWORM CULTURE AT THE COLLEGE OF AGRICULTURE

A house for silkworm culture was built on the campus last year. It is six and one-half by eight meters, built on a concrete base surrounded by water trough, screened, and with overhanging eaves.

The water trough is effective in keeping out ants, except at times when storms cause leaves to be blown into it.

Adjacent to the silk-house there is 0.35 hectare of mulberries which were planted in February 1910. The mulberries are planted in rows 2½ to 3 meters apart and are 1 meter apart in the rows.

The silk-house has been cared for since its start by Blas Velez, Francisco Quisumbing, Francisco Galang, and Valente Villegas. It is now cared for by Galang and Villegas.

The account here given has been written up by Villegas, but each of the others has contributed to it.

On January 10, five pairs of cocoons were brought from the Bureau of Science at Manila.

The worms are of the hybrid breed used at the Bureau of Science. Since starting work with them in January, there have been five generations. The different stages in the development have occurred as indicated in the following table:

	Moths emerge	Eggs laid	Eggs hatched	First Molt	Second Molt	Third Molt	Fourth Molt	Pupating
First Brood.....	Jan. 12	Jan. 12	Jan. 22	Jan. 25				
Second Brood...	March 4	March 5	Mch. 15	Mch. 18	Mch. 22			
Third Brood.....	April 16	April 17	April 26	April 29	May 2	May 6	May 10	May 15
Fourth Brood...	May 28	May 29	June 6	June 9	June 12	June 15	June 19	June 26
Fifth Brood....	July 7	July 8	July 17	July 21	July 24	July 29	Aug. 2	Aug. 10

SILKWORM CULTURE

V. Villegas

Silkworm culture may be classed as one of the Philippine industries which may be conducted with as much profit as hat-making. Like that industry it can be handled by boys and girls. The work is not heavy, but it requires patience and care. The boys can gather the mulberry leaves and the girls can rear the worms.

The worms are the larvae of the moths which therefore have to undergo three stages in order to complete their whole life cycle, moths, larval, and pupal stages. It is in the pupal stage that the worms cover themselves with the yellowish threads from their own bodies known as the silk, which is the real commercial highly priced product from this industry.

(*Continued on page. 121*)

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COLLEGE NEWS

Dr. H. G. Deming has offered four prizes of five pesos each to the four students in Chemistry I receiving the highest grades in the subject from September 15th to the end of the school year. The names of the winners will be published in the *Philippine Agriculturist and Forester*, and possibly in the college catalogue.

Dr. Foxworthy has also offered a five-peso prize to the student in Economic Entomology presenting the best collection of insects.

The classes in Animal Husbandry I and II are planning a trip to Lipa, Batangas, for a horse-judging. Mr. Durham has offered a ten-peso prize to the student presenting the best "scale of points," and a five-peso prize to the one having the next best.

Beginning from next month, the library of the college and the reading circle of the Student Body will be open from six to nine in the evening to give the students a more ample use of the reference books and other publications than they have had so far.

WEATHER OBSERVATIONS

Since the middle of August records of rainfall and temperature have been kept using a rain-gauge and registering psycrometers.

It is hoped that the records can be completely kept in the future.

AUG.	RAINFALL	TEMPERATURE	
		Maximum	Minimum.
15			
16		30.7° C.	22.9° C.
17		30.5° C.	22.6° C.
18	24.638 mm.	26.9° C.	23.0° C.
19	28.448 mm.	27.3° C.	22.0° C.
20	16.51 mm.	26.7° C.	22.4° C.
21	5.334 mm.	28.5° C.	22.0° C.
22		28.0° C.	20.3° C.
23	.254 mm.	28.9° C.	21.0° C.
24		27.4° C.	21.0° C.
25	27.432 mm.	26.1° C.	22.2° C.
26	1.016 mm.	29.5° C.	22.9° C.
27		29.3° C.	22.9° C.
28		28.0° C.	23.6° C.
29		29.8° C.	22.9° C.
30		27.5° C.	24.0° C.
31	1.524 mm.	29.6° C.	25.0° C.
Total	105.158 mm.		
Daily average		28.41° C.	22.54° C.

The larvae are the only ones that eat. The method of rearing them is as follows:

The life of the worms or larvae is divided into five ages. The first age comprises the four days between the hatching of the eggs and the first molting, the second, third, and fourth ages comprise the four days interval between the corresponding molting periods, and the fifth age comprises the days between the last molting and pupating.

Molting takes place for almost a whole day or more. However, molting begins and ends earlier if the temperature is high. As a general rule the number of days needed for the worms to complete their life as larvae is 18.

FIRST AGE

The first thing to do at the very first day of this stage is to collect the youngest leaves of the mulberry trees and cut them into the smallest fragments possible. Then scatter the leaves over a large spread piece of paper. Turn over theworms on the paper, where they have hatched until all are on the leaves. This may be done at somewhere about ten o'clock in the morning. On the following days they may be fed by similar leaves until their first molting period. They must be fed at least three times a day and two layers of leaves may be given at every application. The time may be stated as between 6 and 9 a. m., 1 and 3 p. m., and 4 and 6 p. m.

When the beds are filled with dry old waste parts of the leaves, the worms may be allowed to crawl through the holes of coarse *sinamay* cloth over them and then young leaves may be scattered over the cloth, thus attracting the worms to crawl upwards. Avoid giving, at the first, a large amount of leaves for irregularity in size of the worms will result. When all the worms are on the new bed, they may be supplied with abundant food.

Care must be taken that worms are not crowded together, for then the supply of fresh air would be hindered.

The worms are at this age blackish in color and are so tiny that they are about 2 mm. in length only and one-third millimeter in width. The body is covered wholly with tiny hairs. As the worms grow the color changes to whitish until, at the molting period, they are of a brownish color.

At the molting period the worms are having a hard time in changing their skin so they must not be disturbed. That is, they must not be fed nor allowed to crawl over other beds. One must, however, spread some leaves over the worms at the beginning of molting to enable the small worms to reach the same size as the big ones.

SECOND AGE

No food must be given just after molting for irregularity in size will result because of the advantage to the worms which have finished first.

The worms after molting have a grey color and are very active in search of food. After a few days the worms enlarge and assume the characteristic greenish color.

The next older leaves must given to these worms and the leaves must be cut into such sizes as 2 cm. in length and 5 mm. in width. The feeding may be performed four times a day; thus dividing the day into four periods, beginning and ending at six o'clock. The amount must be such that the worms are covered with two layers of leaves at the beginning of feeding.

It must always be borne in mind that as soon as the beds are filled with waste parts of leaves they must be renewed, and this can be accomplished in the same way as above described.

In this stage the worms cannot pass through the holes of the sinamay cloth on account of their larger size, so that bamboo trays with holes of 1 by 1 cm. may be substituted.

The presence of molds in the trays may be avoided by drying them in the sun.

There must be a space between each two individuals of about one-half centimeter, so that the worms may have plenty of fresh air.

THIRD AGE

The leaves that must be given to the worms of this age must be the ones ranging from the third leaf from the top downward to the eighth one. These leaves may be cut into pieces of 2 cm. in width and 3 in length, or in other words, the pieces may be cut in such a way that a leaf may be lengthwise and crosswise divided into three. The feeding may be performed at any time that the worms seem to search for food, and this can be recognized by the constant wandering around of the worms. When the worms are still, with their heads up, it shows that they are satisfied; that is, if they are not at their molting period. Growth of the worm at this time is more rapid than in the preceding ages so that one can distinctly recognize the difference of growth every four-hour interval during the whole day. The distance between the individuals on the trays must be still wider at this age.

FOURTH AGE

At this age the worms eat still more rapidly than in the preceding ones, so that the breeder must often visit the worms in order that he may know whether they are hungry or satisfied. The color of the worms at this age is sensibly the same as that during the two preceding ages.

FIFTH AGE

Before this age is attained, an observer will see that the last molting lasts for a longer time than the earlier ones. Following this molt, the worms will look as if they were sick, due to their wrinkled pale and decreased body. But as soon as they have finished molting, their appetite is very great. They exhaust, in a few minutes, a layer of leaves placed over them. The up and down swelling of the skin, which is caused by the breathing of these creatures, is very noticeable at this age. At about the end of this age the worm becomes yellowish, indicating the approach of the period of pupation.

PUPATING

The breeder must, for a few weeks, collect clean cogon, which may be dried while the worms are being bred. Then they may be laid crosswise to each other in a box or tray in such a way as to give enough space between the leaves to enable the attachment of the cocoons. The worms which are about to pupate are placed below the mass of cogon. But afterwards they crawl all over the mass, and later on almost fill it. The number of worms in the mass must be such that enough space is allowed for the cocoons. Cocooning takes place during the whole forty-eight hours. The pupal stage lasts for ten days, and then the moths emerge. For this reason it is advisable for one to kill the cocoons as soon as the pupating is finished. Before killing the cocoons, one must select large sized ones to be used for the next breeding. Males can be recognized by the pointed ends and generally smaller size of the cocoons, while females have oval ends and are larger. After the males and females have come out they are paired together and enclosed in a bamboo ring. Here they copulate and for the next day the females lay eggs.

The eggs hatch within ten days.

METHOD OF KILLING COCOONS

A can of water is heated to boiling. Then trays are placed over the can. The level of the water must be such that when it boils the trays are not touched. The cocoons are placed on the trays. Te determine the length of time required to kill the pupa a cocoon is opened at intervals. The time thus determined is then used in killing other cocoons.

ENEMIES AND DISEASES

Lizards, spiders, and rats cause trouble if allowed in the silk house. The lizards and spiders will eat the larvae, and the rats, the cocoons.

During the third and fourth molt, some of the worms develop very slowly and irregularly and seem to have a sort of dysentery. The abdomen, about the anal opening, becomes red and swollen and the worm dies. A few worms of each generation have been affected this way and have been destroyed.

In the third and fourth broods, it was found at the time of pupating that a few of the worms ceased to emit silken threads, turned black and died, giving off a foul odor.

At the time of hatching of the last brood there was a severe typhoon, which destroyed many of the young mulberry leaves. It was feared that the young worms could not thrive on the older mulberry leavest but they have done very well, excep; that the cocoons are of smaller size than those of previous generations.

Current Literature

A study on the composition of the rice plant has been undertaken by the Hawaiian Agricultural Experiment Station, and published as Bulletin No. 21. The same station recently published Bulletin No. 24, "The Assimilation of Nitrogen by Rice," from which the following is extracted:

THE ASSIMILATION OF NITROGEN BY RICE

FIELD TRIALS

"The plots used in these experiments were separated by low dikes constructed of puddled soil, and rendered practically impervious to the passage of water in order to prevent interchange of fertilizers..... The soil after being thoroughly prepared is flooded and completely submerged before transplanting the seedlings and the irrigation is usually continued throughout the main growing period." In Hawaii the seedlings are transplanted at the age of twenty to thirty days.

The plots used for the experiments were divided into four of one acre each. To one plot ammonium sulphate was applied, and to another nitrate of soda. The third plot received ammonium sulphate at intervals of (ten) days in six equal applications, and the fourth received nitrate of soda also in six equal applications at intervals of ten days. To each plot the same amount of nitrogen, 70 pounds, was applied.

In three harvests, it was found that ammonium sulphate greatly increased the production of straw and grain, and that nitrate of soda produced little or no effect. Ammonium sulphate applied before planting was more effective than the same applied at intervals. The same case was true in the nitrate of soda. The ineffectiveness of the latter was probably due to its leaching out, which does not happen in the same measure to the ammonium sulphate.

POT EXPERIMENTS

The soil used for these experiments was taken from the rice field after having been aerated for two months. By analysis it was found to contain 0.189% of total nitrogen, 55 parts per million of nitrates, 10.8 parts per million of ammonia, and a trace of nitrites.

The pots employed were of a Japanese design and made of glazed porcelain provided with an aperture at the bottom. "Each pot was filled by placing a layer of gravel in the bottom, on the top of which were placed about two inches of coarse volcanic sand, and then 4K of well prepared soil. Each pot received the same

quantity of basic fertilizer composed of potassium sulphate and superphosphate. The soil was neutral, and in addition was not deficient in lime.

Seven series of fertilizers were used, I $Ca(NO_3)_2$ II $Mg(NO_3)_2$, III $NaNO_3$, IV $(NH_4)_2 SO_4$, V Soja Bean Cake, VI $NaNO_3$ (in four applications). An eighth series of three pots was used as check. Each kind of fertilizer was applied in three pots, each of which received 0.6 gram of nitrogen. The entire amount of the fertilizers except in series VI and VII was thoroughly mixed with the dry soil.

Five uniform seedlings of rice of a Japanese variety were transplanted to each pot April 15. The soil in the pots was irrigated on each succeding day to replace any loss. The pots in series III received another application on May 28 making the nitrogen in these pots double that of the other. The nitrogen for series VI and VII was divided into four equal parts and applied at intervals of ten days. The first application was made before planting.

Tests for nitrates and nitrites were made on the soil and water in the pots during the growth of the rice. The tests showed that nitrites were formed in all the pots in five to ten days after having been irrigated, and that they were developed in the pots to which nitrates have been added. After twenty days only a faint reaction for nitrites was obtained in all cases except in series III and VI. In series VI and VII nitrites usually disappeared within five to ten days following the application.

At the end of twenty three days, the nitrate content of the soil was reduced to a minimum except in cases where repeated applications were made; whereas the ammonia content was maintained, and increased by the application of ammonium sulphate or soja-bean-cake.

As to the effect of the fertilizers used in the experiments, we quote the following:

"The effects of the ammonium sulphate were noticeable within one week from the time of transplanting and became more and more apparent throughout the main growing period. Soja-bean-cake produced results intermediate between the unfertilized and the ammonium sulphate series. . . . The average number of fruiting stems produced from the use of ammonium sulphate was six for each seedling transplanted, while the unfertilized and nitrate series each had an average of three. Nitrates appeared to exert no influence on the rice neither in the size and number of the fruit in stems, nor in its color and appearance until the crop had passed through a considerable period of its growth."